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EXAMINER
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SMITH, JACKSON R

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1709

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

10/807,103

Applicant(s)

MATSUDA ET AL.

Examiner

Jack Smith

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
  - 2) ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. ____                                       |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>4/19/05, 8/3/05, 8/22/05</u> .                                | 6) <input type="checkbox"/> Other: ____                           |

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. Note that the reference: Yamamoto, Kenji, "Thin-film polycrystalline Silicon Solar Cell", Applied Physics, The Japanese Society of Applied Physics: May 2002, Vol. 71 No. 5, pp. 524-527. was included on two information disclosure statements (those received by the office from the applicant on 4/19/05 and 8/3/05). Therefore, the examiner has lined through this reference on the information disclosure statement received by the office on 4/19/05 and initialed the reference only on the document received by the office on 8/3/05.

### ***Specification***

2. The disclosure is objected to because of the following informalities: several typographical errors and unclear language.

The following sentence on page 15 is particularly unclear as to the meaning of the zinc oxide layer's being "sufficiently thin": "Although the first photovoltaic element 305 is provided with the first zinc oxide layer 304 of lower resistivity on the substrate side surface, it is sufficiently thin and causes spread of short-circuit current in the lateral direction only to a limited extent." It seems as if the author means that the thickness of this layer is small enough to limit lateral spreading of short-circuit currents. However, this is not explained. The sentence that concludes the same paragraph (i.e., "Therefore, it little deteriorates the characteristics") should be replaced with "Therefore, it causes only minor deterioration of the photovoltaic element characteristics." There

are many more passages with similar problems with clarity of language throughout the text.

Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 9-13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 9-11 are labeled as "methods" for producing a stacked photovoltaic element but they recite no steps for producing the element. Instead, they only list the structural features of the element. In order to interpret the claims on their merits, the claims have been interpreted as calling for any method that provides the recited structure.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okada et al. (US Patent 7,189,917) in view of Nakajima et al. (Japanese Patent Application Publication 2000-150934).

As to claim 1, Okada et al. show a stacked photovoltaic element (stacked photovoltaic device, 300, depicted in Figure 1) comprising a plurality of unit photovoltaic elements (first photovoltaic device, 305, second photovoltaic device, 303) each composed of a pin-junction (Okada et al. explain that 305 may be a "pin junction" in line 13 of column 6 and that 303 may be a "pin junction" in line 22 of column 5), connected to each other in series (as shown in Figure 1). Okada et al. further describe, as part of their invention, a "selective reflection layer" (304) that is preferably composed of zinc oxide (column 5, line 42). This barrier layer is shown in both Figures 1 and 2 as being provided between the unit photovoltaic elements 305 and 303. What Okada et al. fail to disclose is that the resistivity of the zinc oxide selective reflection layer varies in the direction of its thickness.

Nakajima et al. disclose photovoltaic cell (Drawing 1) that contains a zinc oxide diffusion barrier layer (4) with a non-uniform concentration of metallic impurities (e.g., 1-3 wt. % aluminum, paragraph 0013). As Nakajima et al. explain in paragraph 0004, the addition of metallic impurities such as aluminum or gallium to the zinc oxide layer raises the conductivity of this layer and leads to an improved junction between the zinc oxide layer (4) and subsequent photo-electric conversion layers (3) of the device. The concentration of metallic impurities in the zinc oxide layer is chosen to be non-uniform (i.e., greater at the end of the zinc oxide layer that contacts the photo-electric

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conversion layer than at the opposite end of the zinc oxide layer) so that the said junction may be improved without compromising the light-transmissive properties of the zinc oxide layer (paragraph 0004). Nakajima et al. further teach that this non-uniform concentration may be either composed of "a plurality of layer constitutions having different impurity concentrations" or be a single layer with a "graded" impurity concentration (abstract). Any such graded concentration of metallic impurity along the direction of the thickness of a zinc oxide film would necessarily create a corresponding gradient in the resistivity of said film given that the presence of the metallic impurity changes the conductivity of the zinc oxide (paragraph 0004). It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the non-uniform impurity concentration of Nakajima et al. to the device of Okada et al., so that the end of the zinc oxide film with the higher concentration of metallic impurity would be at the junction between this zinc oxide layer and the n-layer of the second photovoltaic device (303), in order to improve the junction without compromising the light-transmissive properties of the zinc oxide layer.

As to claim 2, applying the impurity concentration of Nakajima et al. to the device of Okada et al. as described above would necessarily create a zinc oxide layer with a lower resistivity on the side of the zinc oxide layer that is in contact with the n-layer of the second photovoltaic device (303).

As to claim 3, applying the graded impurity concentration of Nakajima et al. to the device of Okada et al. as described above would necessarily create a continuous decrease in the resistivity of the zinc oxide from the side in contact with the p-layer of

the first photovoltaic device of Okada et al. (305) towards a side of the zinc oxide layer in contact with the n-layer of the second photovoltaic device of Okada et al. (303). This is so because the resistivity is inversely related to the concentration of metallic impurities which, as described above, would continuously increase in the zinc oxide layer from the side in contact with the p-layer of the first photovoltaic device of Okada et al. (305) towards a side of the zinc oxide layer in contact with the n-layer of the second photovoltaic device of Okada et al. (303).

As to claims 4 and 5, Okada et al. give a preferred sheet resistance for their zinc oxide selective reflection layer between  $5 \text{ M}\Omega/\square$  and  $50 \text{ M}\Omega/\square$ . Given that the thickness of said film may range between 0.1 – 10 microns, this translates into a range of resistivity between  $50 \text{ }\Omega\text{cm}$  and  $5 \times 10^4 \text{ }\Omega\text{cm}$  which overlaps with the range given in claim 4 ( $2 \times 10^0 \text{ }\Omega\text{cm}$  and  $5 \times 10^3 \text{ }\Omega\text{cm}$ ) as well as the range given in claim 5 ( $5 \times 10^2 \text{ }\Omega\text{cm}$  and  $5 \times 10^3 \text{ }\Omega\text{cm}$ ). As explained in MPEP 2144.05 ("Overlap of Ranges"): "in cases where the claimed ranges overlap or lie inside ranges disclosed by the prior art a prima facie case of obviousness exists." Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose a resistance for the zinc oxide layer of Okada that occurs in the ranges specified by these claims.

As to claim 6, Okada et al. state that a preferred embodiment for the first photovoltaic device (305) is "pin-type amorphous Si:H" (column 6 line 21).

As to claim 7, Okada et al. state that either the first or the second photovoltaic devices (305 and 303) may be composed of layers of microcrystalline Si (column 5 lines 20-23 and column 6, line 16-17).

As to claim 8, Okada et al. state that either the first or the second photovoltaic devices (305 and 303) may be composed of layers of single- crystalline or poly-crystalline Si (column 5 lines 20-23 and column 6, line 16-17).

As to claims 9 and 14, Okada et al. show a stacked photovoltaic element (stacked photovoltaic device, 300, depicted in Figure 1) comprising an intermediate layer (selective reflection layer, 304) between photovoltaic elements (first photovoltaic device, 305, second photovoltaic device, 303) each having a pn- or pin-junction. Okada et al. explain that 305 may be a "pin junction" in line 13 of column 6 and that 303 may be a "pin junction" in line 22 of column 5). Okada et al. further disclose that said intermediate layer may be composed of indium oxide in column 5, line 39 and show that this layer is stacked on the interface with the photovoltaic element (303) in Figure 1. What Okada et al. fail to disclose is a second layer as part of this intermediate layer that is mainly composed of zinc oxide and is stacked on the first layer.

Nakajima et al. disclose a photovoltaic cell (Drawing 1) that contains a zinc oxide diffusion barrier layer (4). As Nakajima et al. explain in paragraph 0003, the primary purpose of said diffusion barrier layer to prevent diffusion between upper layers of the stacked photovoltaic device and the individual photovoltaic elements. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the zinc oxide diffusion barrier layer of Nakajima et al. as the second to the intermediate layer of Okada et al. (i.e., between the first and second photovoltaic devices, 305 and 303) in order to prevent diffusion between upper layers of the stacked photovoltaic device and the individual photovoltaic elements.



As to claims 10,11,15 and 16, the combination of Okada et al. and Nakajima et al. is applied to claims 9 and 14 as detailed above. Nakajima et al. further disclose that the diffusion prevention layer of Nakajima et al. (i.e., the second layer of the combined device) is formed with a thickness of 0.15 microns (paragraph 0039) while the lower limit of the thickness of the indium oxide layer (i.e., the first layer in the combined device) is given by Okada et al. as 0.2 microns (column 6, line 2). Therefore, the modified device of Okada et al. fails to provide that the first layer of the intermediate layer is thinner than the second. It has been held, however, that where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. In re Rose , 220 F.2d 459, 105 USPQ 237 (CCPA 1955); In re Rinehart, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); In Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984). Also see MPEP 2144.

As to claim 12, the combination of Okada et al. and Nakajima et al. is applied to claim 9 as detailed above. Further, the deposition conditions listed for the second layer (zinc oxide layer) of Nakajima (paragraph 0061) confirm that it was formed at a higher rate than was the first layer (indium oxide layer) in the intermediate layer of the combination of Okada et al. and Nakajima et al. In particular, the power used in the RF generator to sputter deposit the second layer (paragraph 0061, Nakajima et al.) is as

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high as 800 W while that used to deposit the first layer with the DC sputtering power source of Okada et al. is only 650 W (Column 9, line 61).

As to claim 13, the combination of Okada et al. and Nakajima et al. is applied to claim 9 as detailed above. Further, the first layer (indium oxide layer) is formed at a higher temperature (i.e, 150 °C, column 9, line 60 of Okada et al.) than was that of the second layer (room temperature, or 22.5 °C, paragraph 0060, Nakajima et al.).

As to claim 17, it is an inherent property of zinc oxide films similar to the second layer in the intermediate layer of the modified device of Sano et al. to have a higher transmittance of 800 nm light than indium oxide prepared as in a similar manner as the first layer. For an example of the former see Minami et al. (T. Minami, H. Nanto and S. Takata, "Highly conductive and transparent zinc oxide films prepared by rf magnetron sputtering under an applied external magnetic field", Applied Physics Letters 41, 958-960 (1982)) which gives the optical transmission in the range of 400-800 nm for such films as 85 % (abstract). Further, Agashe et al. (C. Agashe, O. Kluth, G. Schöpe, H. Siekmann, J. Hüpkes and B. Rech "Optimization Of The Electrical Properties Of Magnetron Sputtered Aluminium Doped Zinc Oxide Films For Opto-Electronic Applications" Proceedings of the 4th International Conference on Coatings on Glass : Braunschweig, Germany. - 2002. - S. 529) show that doping of zinc oxide with aluminum does little to change this value in Figure 2. For an example of indium oxide, see Figure 2 on page 3 of Von Rottkay et al. (K. Von Rottkay, M. Rubin, N. Ozer, "Optical Indices of Tin-Doped Indium Oxide and Tungsten Oxide

Electrochromic Coatings", Mater. Res. Soc. Symp. Proc. 403, 551-556. (1995)) which gives the optical transmission at 800 nm for such films as lower than 80 %.

6. Claims 1-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sano et al. (US Patent 6,180,870 B1) in view of Ishihara et al. (US Patent 5,021,100) and in further view of Nakajima et al. (Japanese Patent Application Publication 2000-150934).

As to claim 1, Sano et al. show a stacked photovoltaic element (stack type photovoltaic device, depicted in Figure 1) comprising a plurality of unit photovoltaic elements (top cell, 150, middle cell, 140, and bottom cell, 130) each composed of a pin-junction ("pin structures", column 5, line 31), connected to each other in series (as shown in Figure 1). What Sano et al. fail to disclose is a zinc oxide layer provided at least one position between the unit photovoltaic elements.

Ishihara et al. disclose a stacked photovoltaic element ("multiple cell photovoltaic device", Figure 1) that contains an upper solar cell (second solar cell, 12) and a lower solar cell (first solar cell, 11) and that are separated by a selective reflection film (8). As Ishihara et al. explain in column 2, lines 42-47, the purpose of the selective reflective film is to reflect short wavelength light which may be absorbed by the upper solar cell (12) and to transmit long wave-length light which is not absorbed by the upper solar cell (12) and may be absorbed by the lower solar cell (first solar cell, 11). Ishihara et al. teach in column 2 lines 47-51 that this increases the photocurrent generated in the upper cell without reducing the current generated in the lower cell "thereby balancing the photocurrents in the respective cells." Ishihara et al. further teach that the material

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for the selective reflection layer may be zinc oxide (ZnO) in column 4, line 54. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the selective reflection layer of Ishihara et al. between each of the photovoltaic elements of Sano et al. (i.e., at the junction in which 150 is the upper cell and 140 is the lower cell, and at the junction in which 140 is the upper cell and 130 is the lower cell) in order to increase the photocurrent generated in the lower cell without reducing the current generated in the upper cell and thereby balance the photocurrents in the respective cells. What the zinc oxide layer selective reflective layer of Ishihara et al. (and, therefore, the modified device of Sano et al) fails to provide is that the resistivity of the zinc oxide selective reflection layer varies in the direction of its thickness.

Nakajima et al. disclose photovoltaic cell (Drawing 1) that contains a zinc oxide diffusion barrier layer (4) with a non-uniform concentration of metallic impurities (e.g., 1-3 wt. % aluminum, paragraph 0013). As Nakajima et al. explain in paragraph 0004, the addition of metallic impurities such as aluminum or gallium to the zinc oxide layer raises the conductivity of this layer and leads to an improved junction between the zinc oxide layer (4) and subsequent photo-electric conversion layers (3) of the device. The concentration of metallic impurities in the zinc oxide layer is chosen to be non-uniform (i.e., greater at the end of the zinc oxide layer that contacts the photo-electric conversion layer than at the opposite end of the zinc oxide layer) so that the said junction may be improved without compromising the light-transmissive properties of the zinc oxide layer (paragraph 0004). Nakajima et al. further teach that this non-uniform concentration may be either composed of "a plurality of layer constitutions having

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different impurity concentrations" or be a single layer with a "graded" impurity concentration (abstract). Any such graded concentration of metallic impurity along the direction of the thickness of a zinc oxide film would necessarily create a corresponding gradient in the resistivity of said film given that the presence of the metallic impurity increases the conductivity of the zinc oxide (paragraph 0004). It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the non-uniform impurity concentration of Nakajima et al. to the zinc oxide selective reflection layers of the modified device of Sano et al. (so that the end of the zinc oxide film with the higher concentration of metallic impurity would be at the junction between the n-layer of 150 and the zinc oxide selective reflection layer separating 150 from 140, and at the junction between the n-layer of 140 and the zinc oxide selective reflection layer separating 140 from 130) in order to improve the junction between the zinc oxide layer and subsequent photo-electric conversion layers of the device without compromising the light-transmissive properties of the zinc oxide layer.

As to claim 2, applying the impurity concentration of Nakajima et al. to the modified device of Sano et al. as described above would necessarily create a zinc oxide layer with a lower resistivity on the side of the zinc oxide layer that is in contact with the n-layer of each of the upper photovoltaic devices (i.e., 140 and 150).

As to claim 3, applying the graded impurity concentration of Nakajima et al. to the modified device of Sano et al. as described above would necessarily create a continuous decrease in the resistivity of the zinc oxide from the side in contact with the p-layer of the upper photovoltaic device towards a side of the zinc oxide layer in

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contact with the n-layer of the lower photovoltaic device. This is so because the resistivity is inversely related to the concentration of metallic impurities which, as described above, would continuously increase in the zinc oxide layer from the side in contact with the p-layer of the upper photovoltaic device towards a side of the zinc oxide layer in contact with the n-layer of the lower photovoltaic device.

As to claims 4 and 5, one of ordinary skill in the art would tailor the concentration of metallic impurities in the graded impurity concentration of Nakajima et al. provided to the modified device of Sano et al. as needed in order to improve the junction between the zinc oxide layer and the subsequent photo-electric conversion layers of the device as instructed in by Nakajima et al. in paragraph 0005. Although Nakajima et al. do not report the sheet resistance of the layer, it has been shown that a few atomic % of Al-doping of zinc oxide films can give sheet resistances well within the range of claim 4 (i.e.,  $2 \times 10^0 \Omega\text{cm}$  and  $5 \times 10^3 \Omega\text{cm}$ ) or claim 5 ( $5 \times 10^2 \Omega\text{cm}$  and  $5 \times 10^3 \Omega\text{cm}$ ). For this see Figure 1 of Rabadanov et al. (R. A. Rabadanov, M. K. Guseikhanov, I. Sh. Aliev and S. A. Semiletov, "Properties of metal-zinc oxide contacts", *Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika*, 6, 72–75 (1981)).

As to claim 6, Sano et al. state that the i-type layer (113) of the uppermost cell (150) may be composed of amorphous silicon in column 8 lines 6-8. Sano et al. further specify that said amorphous silicon may be a-Si-H in column 8 line 41.

As to claims 7 and 8, Sano et al. state the i-type layer (110) of the middle cell (140) is composed of microcrystalline silicon in column 8, line 9. Since microcrystalline

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silicon is a form of polycrystalline silicon, the same line indicates that the i-type layer of the middle cell may be composed of polycrystalline silicon.

As to claims 9 and 14, Sano et al. show a stacked photovoltaic element (stack type photovoltaic device, depicted in Figure 1) comprising a plurality of unit photovoltaic elements (top cell, 150, middle cell, 140, and bottom cell, 130) each composed of a pin-junction ("pin structures", column 5, line 31), connected to each other in series (as shown in Figure 1). What Sano et al. fail to disclose is an intermediate layer between photovoltaic elements.

Ishihara et al. disclose a stacked photovoltaic element ("multiple cell photovoltaic device", Figure 1) that contains an upper solar cell (second solar cell, 12) and a lower solar cell (first solar cell, 11) and that are separated by an intermediate layer (selective reflection film, 8). As Ishihara et al. explain in column 2, lines 42-47, the purpose of the selective reflective film is to reflect short wavelength light which may be absorbed by the upper solar cell (12) and to transmit long wave-length light which is not absorbed by the upper solar cell (12) and may be absorbed by the lower solar cell (first solar cell, 11).

Ishihara et al. teach in column 2 lines 47-51 that this increases the photocurrent generated in the upper cell without reducing the current generated in the lower cell "thereby balancing the photocurrents in the respective cells." Ishihara et al. further teach that the material for the selective reflection layer may be indium oxide (ITO) in column 4, line 54. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the selective reflection layer of Ishihara et al. between each of the photovoltaic elements of Sano et al. (i.e., at the junction in which 150 is the

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upper cell and 140 is the lower cell, and at the junction in which 140 is the upper cell and 130 is the lower cell) in order to increase the photocurrent generated in the lower cell without reducing the current generated in the upper cell and thereby balance the photocurrents in the respective cells. What the intermediate layer of Ishihara et al. (and, therefore, the modified device of Sano et al) fails to provide is an additional layer of zinc oxide stacked on the indium oxide layer.

Nakajima et al. disclose a photovoltaic cell (Drawing 1) that contains a zinc oxide diffusion barrier layer (4). As Nakajima et al. explain in paragraph 0003, the primary purpose of said diffusion barrier layer to prevent diffusion of between upper layers of the device and the photovoltaic device. It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the zinc oxide diffusion barrier layer of Nakajima et al. as the second layer in the intermediate layer of the modified device of Sano et al. in order to prevent diffusion upper layers of the device and each of the lower photovoltaic devices (i.e., 140 and 130).

As to claims 10, 11, 15 and 16, the combination of Sano et al., Ishihara et al. and Nakajima et al. is applied to claims 9 and 14 as detailed above. Nakajima et al. further disclose that the diffusion prevention layer (i.e., the second layer of the combined device) is formed with a thickness of 0.15 microns (paragraph 0039) while the lower limit of the thickness of the indium oxide layer (i. e., the first layer in the combined device) is 0.25 microns (column 4, line 46 of Ishihara et al.). Therefore, the modified device of Sano et al. fails to provide that the first layer of the intermediate layer is thinner than the second. However, it has been held that where the only difference



between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. In re Rose , 220 F.2d 459, 105 USPQ 237 (CCPA 1955); In re Rinehart, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); In Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984). Also see MPEP 2144.

As to claim 12, the combination of Sano et al., Ishihara et al. and Nakajima et al. is applied to claim 9 as detailed above. Although the deposition conditions for the first layer (indium oxide of Ishihara et al.) of the combined device are not listed in the reference, deposition conditions routinely used to make such layers are listed in Martinez et al. (M.A. Martinez, J. Herrero, M.T. Gutierrez, " Optimisation of indium tin oxide thin films for photovoltaic applications", Thin Solid Films 269, 80-84 ( 1995)). In the first paragraph of right column of page 958, Minami et al. teach that appropriate conditions for depositing such a film involve using a power of 30-80 W. The deposition conditions listed for the second layer (zinc oxide layer) of Nakajima (paragraph 0061) confirm that it is formed at a higher power, and therefore a higher rate, than was this first layer (indium oxide layer). In particular, the power used in the RF generator to sputter the deposit the second layer (paragraph 0061, Nakajima et al.) is as high as 800 W.

As to claim 13, the combination of Sano et al., Ishihara et al. and Nakajima et al is applied to claim 9 as detailed above. Although the deposition conditions for the first

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layer (indium oxide of Ishihara et al.) of the combined device are not listed in the Ishihara et al., appropriate conditions for forming such an indium oxide layer are given as 25 – 460 °C in second paragraph of the left column of page 81 of Martinez et al. This is higher than the temperature used to form the second layer or the zinc oxide layer of Nakajima et al. (room temperature or 22.5 °C, paragraph 0060, Nakajima et al.).

As to claim 17, it is an inherent property of zinc oxide films similar to the second layer in the intermediate layer of the modified device of Sano et al. to have a higher transmittance of 800 nm light than indium oxide prepared as in a similar manner as the first layer. For an example of the former see Minami et al. (T. Minami, H. Nanto and S. Takata, "Highly conductive and transparent zinc oxide films prepared by rf magnetron sputtering under an applied external magnetic field", Applied Physics Letters 41, 958-960 (1982)) which gives the optical transmission in the range of 400-800 nm for such films as 85 % (abstract). Further, Agashe et al. (C. Agashe, O. Kluth, G. Schöpe, H. Siekmann, J. Hüpkes and B. Rech "Optimization Of The Electrical Properties Of Magnetron Sputtered Aluminium Doped Zinc Oxide Films For Opto-Electronic Applications" Proceedings of the 4th International Conference on Coatings on Glass : Braunschweig, Germany. - 2002. - S. 529) further show that doping of zinc oxide with aluminum does little to change this value in Figure 2. For an example of indium oxide, see Figure 2 on page 3 of Von Rottkay et al. (K. Von Rottkay, M. Rubin, N. Ozer, "Optical Indices of Tin-Doped Indium Oxide and Tungsten Oxide Electrochromic Coatings", Mater. Res. Soc. Symp. Proc. 403, 551-556. (1995)) which gives the optical transmission at 800 nm for such films as lower than 80 %.

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**Conclusion**

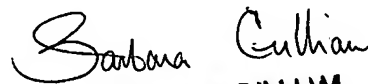
7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Smith whose telephone number is (571) 272-9814.

The examiner can normally be reached on 7:30 a.m. - 5:00 p.m., Mon - Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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JRS



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